भारतीय मानक
Indian Standard

IS 16280 : 2021
(Amalgamation of IS 4786 and IS 16280)

द्रवित पेट्रोलियम गैस (एलपीजी) के साथ उपयोग करने हेतु उच्च दवाब रेगुलेटर एवं एडॉप्टर — विशिष्टि

(पहला पुनरीक्षण)

High Pressure Regulators and Adaptors for Use with Liquefied Petroleum Gases (LPG) — Specification

(First Revision)

ICS 23.060.40; 75.160.30

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Gas Cylinders Sectional Committee, MED 16

FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards on recommendation of the Gas Cylinders Sectional Committee, had been approved by the Mechanical Engineering Divisional Council.

This standard was first published in 2014. This revision is done mainly to amalgamate IS 4786 'Variable high pressure regulators (VHPR) for use with liquefied petroleum gases — Specification (first revision)' and IS 16280 'Unreduced pressure adaptors for use with liquefied petroleum gas (LPG) — Specification'. This standard is revised to incorporate the latest technological development taken place.

In this revision following modification has been incorporated:

a) Mechanical Strength test has been modified; and
b) Reference standards have been updated.

After publication of this standard, IS 4786 stands withdrawn.

In the preparation of this standard considerable assistance has been derived from the following:

a) IS 9798 : 2013 'Low pressure regulators for use with liquefied petroleum gas (LPG) — Specification'.
b) EN 12864 : 2001 'Low pressure non-adjustable regulators having a maximum pressure of less than or equal to 200 m bar with a capacity of less than or equal to 4 kg/h and their associated safety devices for butane, propane or their mixtures'.
c) EN 13785 : 2005 'Regulators with a capacity of up to and including 100 kg/h, having a maximum nominal outlet pressure of up to and including 4 bar, other than those covered by EN 12864 and their associated safety devices for butane, propane or their mixtures'.

Pressures indicated in the various requirements/clauses of this standard are gauge pressure unless otherwise stated.

While implementing this standard compliance with statutory regulations shall be ensured.

The composition of the Committee responsible for the formulation of this standard is given in Annex M.

For the purpose of deciding whether a particular requirement of this standard is complied with the final value, observed or calculated, expressing the result of a test or analysis shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

HIGH PRESSURE REGULATORS AND ADAPTORS FOR USE WITH LIQUEFIED PETROLEUM GASES (LPG) — SPECIFICATION

(First Revision)

1 SCOPE

1.1 This standard specifies materials, construction, performance, safety and testing requirements for the following high pressure devices for use with liquefied petroleum gases (butane, propane and their mixtures) in vapour phase:

a) High pressure regulators (HPR) with outlet pressure above 4.903 kN/m^2 [50 gf/cm^2 or 500 mm water column (WC)] and up to 686.42 kN/m^2 (7 kg/cm^2).

NOTES

1 Generally, LPG appliances are being designed to operate at a pressure of 1 kgf/cm^2, but specialized equipment may call for use of still higher pressures.

2 For terminology related to LPG, refer IS 4576.

b) Adaptors with unreduced outlet pressure and unregulated flow for use with liquefied petroleum gas mixtures in vapour phase up to 1 666 kPa (17 kgf/cm^2) outlet pressure.

NOTE — Adaptors are meant for use in cylinder manifolds in cylinder installation or any other application requiring use of LPG vapour at unreduced pressure for commercial and industrial applications. These adaptors may also be used with cylinder manifolds provided in the reticulated systems in buildings and installed as per the requirement of IS 6044 (Part 1).

1.2 This standard does not cover rules for installation of devices during actual use and reference should be made to applicable rules.

2 REFERENCES

The standards listed in Annex A contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards listed in Annex A.

3 TERMINOLOGY

3.1 High Pressure Regulator (HPR) — A device which delivers a regulated outlet vapour pressure within pre-set limits, irrespective of supply pressure, flow rate and temperature. It may be of the fixed, variable or adjustable type.

3.1.1 *Fixed HPR (FHPR)* — A regulating device whose regulated pressure is adjusted and fixed by the manufacturer and whose adjustment cannot be modified by the user.

3.1.2 *Adjustable HPR (AHPR)* — A regulating device whose regulated pressure may be between two fixed limits but only by a competent person at the time of installation or during maintenance and otherwise remains fixed.

3.1.3 *Variable HPR (VHPR)* — A regulating device whose regulated pressure may be modified by the user with simple manipulation between two fixed limits.

3.2 Unreduced Pressure Adaptor — A device capable of fitment to the valve of a cylinder and having and outlet capable of being connected to an appliance, such that the LPG vapour from the cylinder is allowed to flow freely through the adaptor without any reduction or regulation of pressure. It shall incorporate a manual “on/off” feature and may have other functions.

3.3 Manual On/Off Tap — Arrangement in the regulating device or adaptor for manually stopping or starting gas flow, whenever so intended.

3.4 Inlet Sealing — Preventing inflow of gas from inlet passage into the device, with its operating tap turned OFF.

3.5 Quick Coupling — A connection system which allows the fitting of regulating device or adaptor to a cylinder valve without a threaded connection and without use of tools.

3.6 Threaded Inlet — A connection system which allows the fitting of regulating device or adaptor to a cylinder valve by means of a threaded connection and/or use of tools for fitment/removal.

3.7 Operating Temperatures — The range of temperatures between which the regulating device or adaptor shall operate, depending upon the gas for which the device has be designed, but shall at least be – 20 °C to + 65 °C.

3.8 Operating Inlet Pressures — The range of inlet pressures within which the device is designed to operate.

3.9 Terms Relating to Regulating Device

3.9.1 *Designed Outlet Pressures* — The range of regulated pressures obtainable from the outlet of the regulating device for any inlet pressure (within operating inlet pressures) when using the gas for which the regulating device has been designed.

3.9.2 *Guaranteed Flow Rate* — The minimum assured stable outflow in m^3/h or kg/h, at an Operating Inlet Pressure.

3.9.3 *Lock-up Pressure* — The maximum pressure obtainable at no flow for all values of Operating Inlet Pressures.

3.9.4 *Excess Flow Check Valve* — A valve integral with the regulating device which shut-off the gas flow for any outflows greater by a percentage than the maximum rated flow and allows resumption of flow by manual intervention (after correcting the cause of excess flow).

3.10 Terms Relating to Adaptor

3.10.1 *Rated Capacity* — The highest rate of flow of gas possible from the adaptor at the inlet pressure of 7 kgf/cm^2.

3.10.2 *Non-return Valve (NRV)* — The unidirectional flow valve provided at adaptor outlet to prevent reverse flow.

4 MATERIAL

4.1 All components of device construction shall be made of material compatible with LPG (*see* IS/ISO 11114-1 and/or IS/ISO 11114-2). Materials specified in IS 319, IS 410, IS 617, IS 742 and IS 6912 are recommended for manufacture, but other type of materials may be used with approval of statutory authority.

4.1.1 Brass parts shall not be susceptible to season cracking. The susceptibility to season cracking shall be determined by the method in IS 2305.

4.2 Body and Cover

The body and cover (where provided) of all devices shall be manufactured from zinc base alloy (as per IS 713) or aluminum base alloys, by pressure die-casting or from brass by forging. Chemical composition of material of the pressure die cast body and cover of the device shall conform to IS 742 or Grade 4600 of IS 617 or brass forged confirm to IS 6912. Other types of materials may be used provided the standards of performance, durability and safety of the device are not lowered.

4.2.1 *Finish*

The body and cover of the zinc/aluminum base alloy device shall be painted or powder coated and of brass adaptor shall be passivated/mechanically descaled so as to resist the effect of atmospheric conditions to which the device is exposed during its working life. The colour and type of finish shall be as agreed between the purchaser and the manufacturer.

4.2.1.1 The surface finished components shall be subjected to test for corrosion resistance as per IS 9844. The evaluation of the finish shall be done as per the method given in IS 6009.

4.2.1.2 The painted or powder coated surfaces shall be tested for adhesion of paint by the method described in Annex B.

4.3 Diaphragm Material

The material of the diaphragm used in regulating device shall be of synthetic rubber or other material equally suitable for the application and shall satisfy the following requirements:

4.3.1 The material shall be free from porosity, pits and foreign particles and shall have a smooth non-tacky surface, with minimum talc or bloom.

4.3.2 The material shall be impermeable to the test gas (*see* Annex C) at a pressure of 2.5 times the maximum outlet pressure obtainable from the device when subjected to a suitable permeability and porosity test.

4.3.3 The material shall be such that when the assembled device is subjected to the test specified in Annex D, the diaphragm shall not pull out or burst, at a pressure not exceeding 1.5 times the design outlet pressure.

4.3.4 The material shall be capable of withstanding a clamping pressure of 490 kPa (5 kgf/cm^2) whereby the material itself or the substance with which the fabric layer has been impregnated shall not be pressed away, flow away, or be bruised or otherwise damaged.

4.3.5 The material after immersion (*see* Annex E) for 72 h in pentane or the liquid test gas (*see* Annex C), meet appropriate requirements tabulated in Annex F.

4.3.6 After this test the material shall be still capable of meeting the flexibility requirements of **4.2.7**. Change in hardness values before and after the immersion shall not exceed 15 IRHD [*see* IS 3400 (Part 2)].

NOTE — Tests at **4.3.1** to **4.3.5** are works batch tests. On initial selection of a diaphragm material, it shall also be tested in the test gas (*see* Annex **C**) in the vapour phase for 72 hours, and shall not show a weight or volume change greater than 15 percent.

4.3.7 The material shall not show change of more than 10 IRHD when subjected to ageing of 72 h at 70 °C in accordance with the method prescribed in method A (Low air Speed) or Method B (High Air Speed) in Annex B of IS 3400 (Part 4).

NOTE — For guidance purpose, comparison of Shore A and IRHD hardness are given below:

Shore A	30	40	50	60	70	80	90	100
IRHD	28.9	39.5	50	60.5	70	80	89.5	100

4.3.8 The material shall be such that the flexibility of the diaphragm shall not be impaired after samples of the same have recovered completely to ambient temperature from cooling to –20 °C or heating to 65 °C. For these tests, fully assembled regulating devices are cooled to –20 °C or heated to 65 °C and maintained at these temperatures for 10 minutes and then kept in atmosphere to recover completely to ambient temperature of its own (not by induced heating or cooling). After recovery, the performance of the regulating device shall be re-verified. The results shall be within acceptable limits.

4.4 Valve Pad Material

The material of the valve pad shall be of synthetic rubber or other material equally suitable for the application and shall satisfy the requirements given in **4.3.1, 4.3.5, 4.3.6** and **4.3.7** along with the following:

NOTE — Tests at **4.3.1** and **4.3.5** are works batch tests. On initial selection of valve pad material, it shall also be tested in the test gas (*see* Annex C) in the vapour phase for 72 hours and shall not show any volumetric shrinkage or volumetric increase greater than 10 percent. The loss of plasticizers or other ingredient due to extraction shall not exceed 5 percent by weight.

4.4.2 After immersion (*see* Annex E) as per **4.3.5** the pad shall not show evidence of being forced out of position due to swelling or other cause.

4.5 ‘O’ rings and other Rubber Components

4.5.1 ‘O’ rings and other rubber components shall be suitable for the application and shall satisfy the requirements given in **4.3.1, 4.3.5** and **4.3.6** along with the following:

NOTE — The tests at **4.3.1** to **4.3.5** are work batch tests. On initial selection of a rubber component material, it shall also be tested in the test gas (*see* Annex C) in vapour phase for 72 hand shall not show a weight loss or volume change greater than 15 percent.

4.5.2 The material shall meet the compression set requirements as in Annex F.

5 CONSTRUCTION AND WORKMANSHIP

5.1 For illustration purpose, typical regulating device and adaptor are shown respectively in Fig. 1 and Fig. 2. Any other design as agreed between the purchaser and the manufacturer may also be used provided it meets all requirements of this standard.

5.1.1 The device shall be designed, manufactured and assembled in such a way as to provide satisfactory operation under the installation and service conditions specified by the manufacturer. The device including all the component parts, shall be mechanically strong, of sound construction and of high standard of workmanship and finish.

5.1.2 The device shall be capable of resisting a fall on hard (concrete) surface and continuing to function satisfactorily, when tested as per **6** and **7.1.3**.

5.1.3 The device shall be specified based on the following, as applicable:

a) Gas – Propane, butane or LPG;
b) Connections – inlet and outlet;
c) Filter size (in microns);

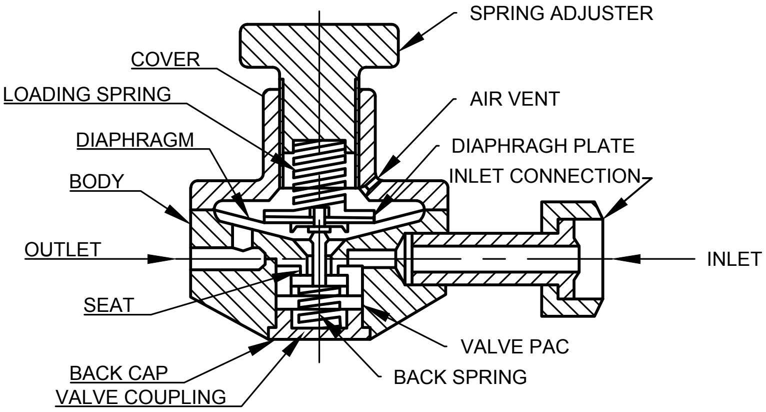
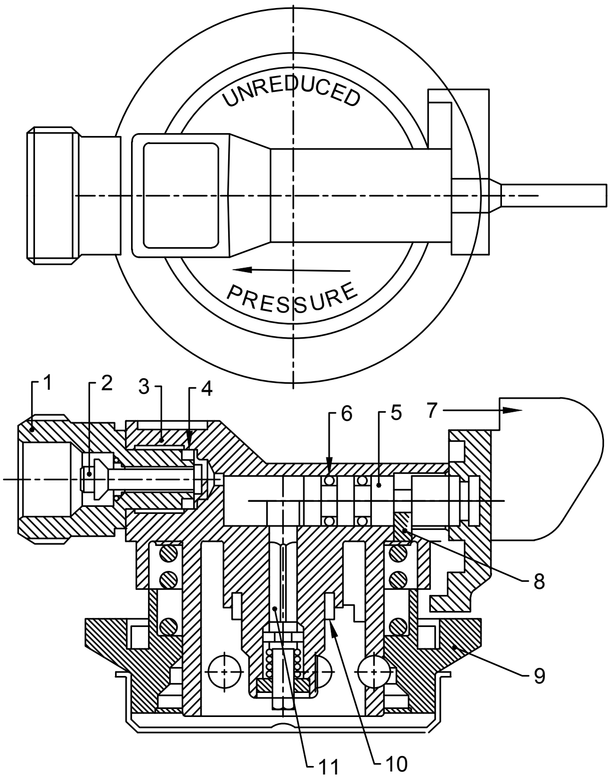


Fig. 1 Diagrammatic Sectional Illustration of a Variable High Pressure Regulator for Liquefied Petrolium Gases



11	WORKING ROD
10	TIGHT JOINT
9	VALVE LOCKING
8	RETAING PIN
7	OPERATING TAP
6	O- RING FOR OTS
5	OPERATING TAP SPINDLE
4	O - RING
3	BODY
2	NRV
1	CONNECTOR
ITEM	DESCRIPTION

FIG. 2 TYPICAL ADAPTOR

d) Operating temperature range in °C;

e) Operating inlet pressure range in kPa (kgf/cm^2);

f) Regulated pressure range (with clean filter) in kN/m^2 or gf/cm^2 or mm WC;

g) Guaranteed flow rate in m^3/h or kg/h (with clean filter); and

h) Adjustments, if any (within outlet pressure range).

5.2 Interchange Ability

The components of a device shall be interchangeable with the corresponding components of any other device of the same model and size.

5.3 Screw Thread

Unless otherwise specified the threads on the inlet and outlet of bodies of devices fitted with screwed ends and not fitted with connectors, shall comply with the requirements of IS 551 or IS 2643 or IS 4218 (Part 1 to Part 4) and shall have sufficient length of threads to provide clearance and prevent bottoming.

5.4 Inlet Connection

5.4.1 Where screwed connections are not used, the inlet of the device shall be cast integrally as an inseparable part of the body or so fixed that it cannot be separated without damaging the body. The size and the profile of the inlet connection shall match the outlet end of the spring actuated, self closing valve as per IS 8737 to achieve a leak proof coupled joint without use of a resilient packing or washer or gasket as a part of the device. However, the use of a gasket or packing shall be permitted so long as there is a leak proof joint with the valve, with the help of the gasket or packing as a part of the valve.

5.4.1.1 Such devices intended to be coupled to self closing valve by a quick coupling means, shall have a handle or an operating tap, for manually turning ON and OFF the gas supply. The ON and OFF positions shall be clearly marked and visible in recommended orientation of use.

5.4.2 Where screwed connections are used for inlet of device, the following shall apply:

5.4.2.1 *Screwed ends*

Where inlet connector is not fitted, the inlet of a device with screwed ends shall comply with the requirements of IS 3224, IS 2643 or IS 4218 (Part 3).

5.4.2.2 *Inlet connector*

Where use, any washer, connector and nut of a screwed inlet union is provided, it shall comply with the applicable mating valve outlet connections as per IS 8737.

5.4.3 The inlet connection shall be designed and manufactured to withstand a minimum hydrostatic pressure of 1.5 times the saturated vapour pressure of the gas at 65 °C, subject to a minimum of 18 kgf/cm^2 for 2 min.

5.4.4 The inlet connection shall also be capable of withstanding at ambient temperature the saturated vapour at 65 °C of the gas with which the device is to be used.

5.5 Inlet Sealing

If required by the customer, the device shall incorporate a feature whereby the inlet passage to the device shall remain sealed and shall prevent inflow of gas from the inlet, whenever the operating tap of the device is brought to OFF position. The inlet valve shall remain effective at all inlet pressures in the range of the saturated vapour pressure of the gas at 65 °C. A device shall be considered to be effective, provided the leakage rate does across the valve not exceed 4 Nmm^3/s.

5.6 Outlet Connection

5.6.1 Outlet of the device shall be provided with outlet connector (which may be an integral part of body when manufactured in brass by forging). The connector shall be of brass and shall be provided with external threads for screw fitting outlet hose/pigtails. The connector shall be fitted in the body of the device using suitable retaining arrangement and shall comply with the outlet valve connection requirements of IS 8737. The choice of type and orientation (horizontal, vertical or skewed) of device outlet shall be as per the agreement between the manufacturer and the purchaser.

5.6.2 Outlet connector of adaptor shall have NRV to restrict the reverse flow of the LPG from the outlet into the adaptor. The NRV shall be considered to be effective, provided the leakage rate does across the NRV not exceed 4 Nmm^3/s

5.7 Body and Cover

5.7.1 The body and cover (where provided) of all device shall be strong enough to withstand the stress of connecting the device to the cylinder valve or piping installation and to withstand normal stress imposed by service conditions, without developing leakage at joints, permanent deformation or other damage which might impair the serviceability of the device.

5.7.2 After machining and before finishing treatment (for example painting) the body shall be pressure tested for porosity with air at a pressure of not less than 1 666 kPa (17 kgf/cm^2) for adaptors and 981 kPa (10 kgf/cm^2) for regulators.

5.8 Valve Pad Fitting

5.8.1 The valve pad (resilient) of the regulating device shall be so retained without use of adhesive that it cannot loosen or work out of position under service conditions.

5.8.2 The inlet orifice and valve pad of the regulating device shall be protected by provision of a filter of suitable material compatible with LPG, of appropriate size of perforations that does not hamper flow of vapour but is yet effective against ingress of contaminating agents in the gas. Any other acceptable arrangement meeting this requirement, as agreed between the manufacturer and the purchaser, is also permitted.

5.9 Vent

The air vent hole (breather hole) above diaphragm space of the regulating device shall be of such a size and so located on the cover that:

a) It does not easily become clogged/blocked;
b) The accidental entry of foreign matter is minimized;
c) It would be difficult for an instrument inserted through the air vent hole to reach the diaphragm; and
d) it does not permit chatter.

NOTE — The purchaser may specify the provision of an insect screen over the vent hole.

5.10 Outlet Pressure Changing Means

The pressure changing means provided in the regulating device for modifying the outlet pressure within the designed range of outlet pressures shall be simple and convenient to operate and once set by user or technician(as applicable), shall remain ‘as set’, till next change. Also, the changing means, shall be so constructed that turning it clockwise will increase the regulator outlet pressure and vice-versa. In case the pressure change is by use of spring load, it shall not be possible for the spring to get compressed to solid height, even by deliberate taking the adjustment to the extreme position of adjustment.

It shall not be possible to set an operating outlet pressure greater than the declared outlet pressure for each type of regulating device tested as per the method given in Annex G.

5.11 Relief Valves

The inclusion of relief valves in regulating device construction is not recommended.

5.12 Excess Flow Check Valve (EFCV)

If an excess flow check valve is included in the construction of the regulating device, its performance shall be specified by the manufacturer and shall meet the requirements given in Annex H.

5.13 Pressure Gauges

Where an outlet pressure gauge is fitted as an integral part of the regulating device the maximum pressure (plus over pressure) which the gauge will withstand shall be at least 30 percent higher than the maximum outlet pressure setting that can be provided by the regulating device (*see* IS 3624).

5.14 Strength of Connections/Device Assembly

5.14.1 *For Inlet Connections*

Whether the fixing of the inlet connection on to the Device body is of the threaded or non-threaded type or in one piece, there shall be no damage or distortion that could affect the safety of the Device at the end of the tests in **7.9** (*see* Table 1) carried out with the following values:

a) A torque of at least 30 Nm in both directions (*see* Table 1); and

b) A tensile strength test of 2 000 N (*see* Table 1).

5.14.2 *For Outlet Connections*

Whether the fixing of the outlet connection on to the Device body is of the threaded or non-threaded type or in one piece there shall be no damage or distortion that could affect the safety of the Device at the end of the tests in **7.9** (*see* Table 2) carried out with the following values:

a) A torque of at least 30 Nm in both directions for threaded and one direction for non-threaded connections (verification not required for freely rotating connections);

b) A bending moment of 10 Nm, (not required for one piece connection) (*see* Table 2); and

c) A tensile strength test of 2 000 N (not required for one piece connection) (*see* Table 2).

5.14.3 For freely, rotating connections, the torque necessary for rotation of the connection shall not be greater than 0.5 Nm at the end of all tests carried out.

5.14.4 *Strength of Device Assembly when Fitted on to a Cylinder Valve*

Under conditions defined in **7.9** (*see* Table 3), the following tests shall be carried out with the device fitted to the installation as indicated in the instructions and there shall be no damage or distortion to the device that could affect the safety of the device:

a) A torque in both directions:
    1) of at least 30 Nm for threaded outlet connections. In addition, devices with screwed unions vertically mounted onto the cylinder valve shall resist a torque of at least 20 Nm in the device plane (15 Nm for quick coupling connections); and

Table 1 Mechanical Strength Test on Inlet Connection of Device (Union/Adaptor Connection)

(*Clauses* 5.14.1 *and* 7.9.2)

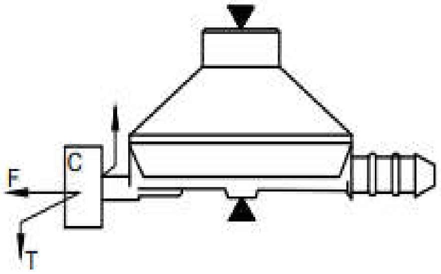
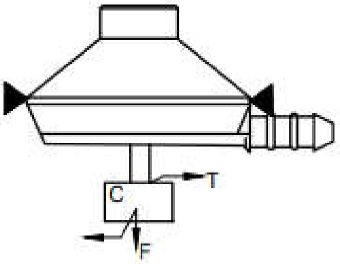
Test diagram	Type of load	Value
	T F	30 Nm 2 000 N
	T F	30 Nm 2 000 N
Key ▲►▼◄ Regulator holding points		
T = torque , F = pulling force, C = inlet connection (*see* **3.5** and **3.6**)		

Table 2 Mechanical Strength Test on Outlet Connection of Device (Union/Adaptor Connection)

(*Clauses* 5.14.2 *and* 7.9.2)

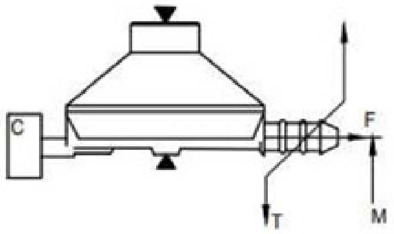
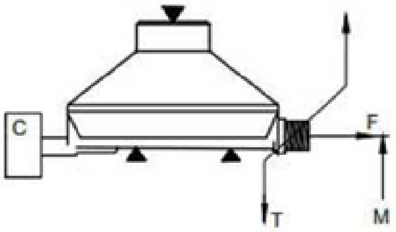
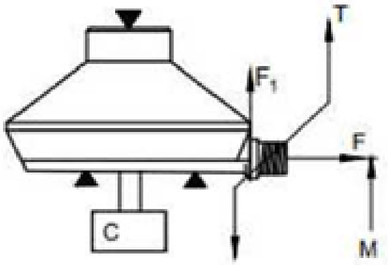
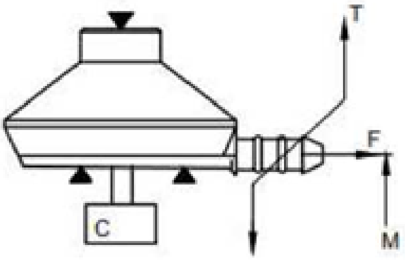
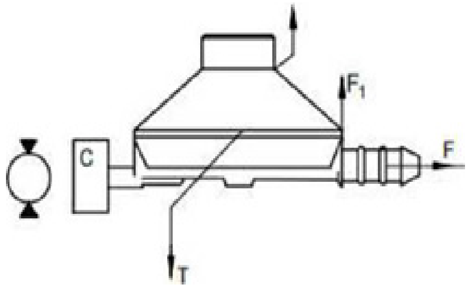
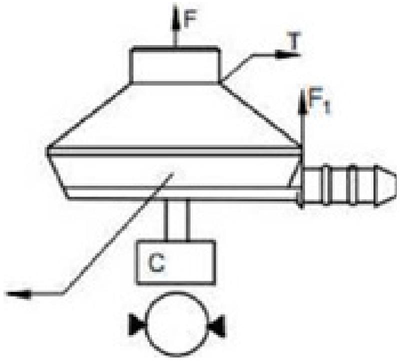
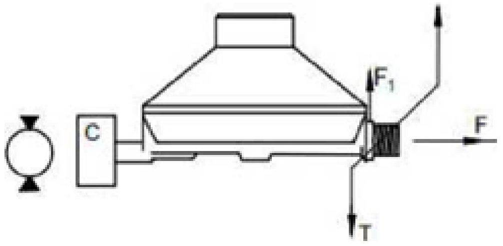
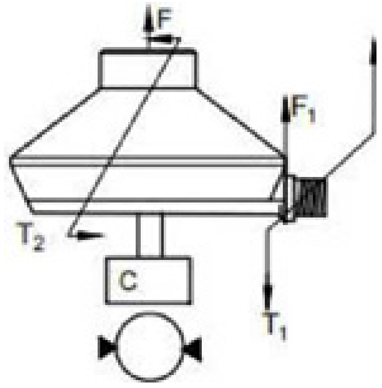
Test diagram	Type of load	Value
	T F M	30 Nm 2 000 N 10 Nm
		
	T F M	30 Nm 2 000 N 10 Nm
		
Key ▼▲ Regulator holding points		
T = torque , F = pulling force, M = bending moment, C = inlet connection (*see* **3.5** and **3.6**)		

Table 3 Mechanical Strength Test for the Device Assembly Mounted on its Cylinder Valve (Self-Closing or Manual Valve)

(*Clause* 5.14.4, 7.9.2 *and* 7.9.3)

Test diagram	Type of load	Value for threaded inlet connection	Value for quick coupling connection
	T F F_1	20 Nm 400 N	15 Nm 500 N 400 N
	T F F_1	20 Nm 400 N	15 Nm 500 N 400 N
	T F F_1	30 Nm 400 N	30 Nm 500 N 400 N
	T_1 T_2 F F_1	30 Nm 20 Nm 400 N	30 Nm 15 Nm 500 N 400 N
Key ▲▼►◄ Regulator fixing points F = pulling force O Valve F1 = bending force, C = inlet connection, (*see* **3.5** and **3.6**) T T_1 T_2 = Torque (T and T_2 are not applied if the regulator is freely turning on its cylinder valve)			

   2) of at least 20 Nm for non-threaded hose outlet connections (15 Nm for quick coupling connections).

b) a bending moment created by a force of 400 N directed upwards and whose application point is at the base of the outlet connection, and

c) a tensile strength test of 500 N (verification not required for inlet connections screwed on to the cylinder valve).

5.14.4.1 The mechanical strength required shall be ensured for all the positions of fixing of the regulator (as indicated in the installation instructions) onto the cylinder.

5.14.5 After all mechanical strength tests the Device shall comply with the soundness test described in **6**.

6 SOUNDNESS

6.1 Device shall be considered leak tight when tested in accordance with **6.2** and **6.3** and if the leakage rate does not exceed 4 N mm^3/s (the symbol N indicates conversion to normal temperature and pressure conditions, NTP that is 760 mm of Hg and 0 ^{o}C).

6.2 Inlet

6.2.1 Those parts of the device normally subjected to full cylinder pressure shall be leak tight at a minimum hydrostatic pressure as per **5.4.3** (subject to minimum of 18 kgf/cm^2) applied and held for a period of 2 min. The pressure shall be applied through the inlet using connecting means of similar dimensions as envisaged in actual use and by keeping the outlet in closed condition.

6.2.2 Those parts of the device normally subjected to full cylinder pressure shall also be tested for soundness at a pneumatic pressure not less than the pressure as per **5.4.4**, applied and held for a period of not less than 30 s and not more than 60 s. The pressure shall be applied through the inlet using connecting means of similar dimensions as envisaged in actual use and by keeping the outlet of the test portion in closed condition.

6.3 Outlet

The completed regulating device shall be leak tight when tested at 2.5 times the maximum outlet pressure obtainable from the regulating device applied through the outlet connection of a fully assembled regulating device and held for a period of not less than 30 s and not more than 60 s, after stability has been achieved. To get stability, adequate time is allowed between introduction of test medium and the start of observation, so that the internal parts have attained balanced positions.

7 TESTING

7.1 General

7.1.1 *Test Gases*

The tests may be carried out with air or the gas for which the device has been designed. In case air is used as the test medium, due provision for a factor of conversion representing the flow of the appropriate gas for which the device is designed shall be made (*see* IS 9798). Unless otherwise specified, tests shall be carried out at ambient temperatures.

7.1.2 *Chatter*

The regulating device using the gas for which it is designed within its entire working range of inlet and outlet pressures shall not chatter or vibrate while it is being tested for performance.

> NOTE — It is improper to induce chatter by striking the regulating device severely or by using an output far in excess of the maximum rated capacity, conditions which may induce vibrations of the internal components and give a false impression of chatter.

7.1.3 *Orientation*

The device when installed shall be capable of operating in all orientations. The standard performance tests shall be carried out with the device in its recommended orientation.

7.2 Outlet Pressure

7.2.1 The designed outlet pressure and range of pressure settings (where applicable) for the entire range of inlet pressures shall be as agreed between the purchaser and the manufacturer.

In the case of regulating device fitted with direct-reading calibrated means of adjustment, the calibrations shall be clear and legible.

7.2.2 *Measurement*

The pipe between the outlet of the regulating device and the outlet pressure gauge shall be of bore not less than the outlet of the regulating device and of length not so long as to create a significant, pressure drop.

7.2.3 *Deviation Limits*

With an initial setting and an inlet pressure as specified by the manufacturer the outlet pressure of the regulating device shall not deviate by more than 10 percent from the setting, at flows measured whilst rising from 10 to 100 percent of the specified test capacity. The static pressure shall not exceed the outlet pressure setting by more than 20 percent.

7.3 Outlet Flow

Outlet flow measurements shall be carried out using a direct indicating flow meter (rota meter). Calibrated orifices may also be used.

7.3.1 Stable outflow of the regulating device shall be measured to establish the Rated Capacities at different inlet pressures.

7.3.2 The rated capacity of the adaptor shall be determined by passing in air at the maximum rated capacity from its inlet at pressure of 7 kgf/cm^2. Measurement of rated capacity shall be carried out using a direct indicating flow meter (rota meter). Calibrated orifices may also be used. The flow observed, shall not be less than the rated capacity.

7.4 Reverse Flow Sealing

The Adaptor shall be checked for tightness of the outlet connector seat and the rubber packing by applying reverse pressure in range of 0.5 kgf/cm^2 to 17 kgf/cm^2 from the outside. The leakage rate from the inlet stub, should not exceed 4 N mm^3/s (the symbol N indicates conversion to normal temperature and pressure conditions, NTP that is 760 mm of Hg and 0 °C).

7.5 Performance of Regulating Device

7.5.1 After setting as in **7.6** and with operating inlet pressure range not narrower than, the range given in Table 4, the outlet or delivery pressure shall not deviate from the setting by more than 20 percent with flows measured whilst rising from 10 percent to 100 percent of the specified test capacity. The static pressure shall not exceed the outlet pressure setting by more than 60 percent for propane/LPG and 30 percent for butane.

7.5.2 These requirements shall also be met after the regulating device has been exposed and has recovered from ambient temperature between – 40 °C and 65 °C for propane and – 20 °C and 65 °C for butane and mixtures of propane and butane.

Table 4 Operating Inlet Pressure Range

(*Clause* 7.5.1)

Sl No.	Gas	Operating Inlet Pressures	
		kPa	kgf/cm^2
(1)	(2)	(3)	(4)
i)	Commercial propane	343 - 1079	3.5 - 11
ii)	Propane/butane mixtures	98 - 687	0.8 - 11
iii)	Commercial butane	78.5 - 314	0.8 - 3.2

NOTE — The foregoing tests are intended as comparative tests, with the 'specified test capacity' laid down by the manufacturers. The maximum capacity will depend on operating circumstance.' and the permissible pressure drop.

7.5.3 The requirements of performance as given in **7.5.1** shall also be satisfied before and after the subjecting the regulating device to the tests specified in **8.8.1**, **8.8.2** and **8.8.3**. Deviation in the initial setting, after these tests, is acceptable.

7.6 Endurance Test

When assessing a new design, a type approval test in accordance with Annex J shall be carried out. A fully assembled regulating device shall withstand a minimum of 5 000 cycles applied to the regulating mechanism, of which 500 cycles shall also include opening and closing operations of the operating handle, after which it shall be subjected to a soundness test as in **6.2** and **6.3** and performance as in **7.5**. On the other hand, in case of an adaptor, a fully assembled adaptor shall withstand a minimum of 5 000 cycles of opening and closing operations, after which it shall be subjected to a soundness test as in **6.2**, **6.3** and performance as in **7.5**.

7.7 Low Temperature Test

The Device is exposed to a temperature of – 20 °C for a minimum period of 10 min for the completely assembled unit to attain this temperature. It is then removed and left exposed to ambient conditions, after which it is tested. The method of carrying out the test is elaborated in Annex K.

7.7.1 If the device is fitted with excess flow check device, the performance of the excess flow check valve shall also be checked as per Annex H.

7.7.2 Subsequent to the cooling, forced heating shall not be applied to bring back the device to ambient temperature.

7.7.3 Care shall be taken to avoid intrusion of fluid or moisture into the device assembly during cooling and recovery. For this the outlet nozzle, the inlet and the breather hole may be plugged.

7.8 High Temperature Test

The device is exposed to a temperature of 65 °C for a minimum period of 10 min for the complete assembled unit to attain this temperature. It is then removed and left exposed to ambient conditions, after which it is tested. The method of carrying out the test is elaborated in Annex J.

7.8.1 If the Device is fitted with excess flow check device, the performance of the excess flow check valve shall also be checked as per Annex H.

7.8.2 Subsequent to the heating, forced cooling shall not be applied to bring back the device to ambient temperature.

7.8.3 Care shall be taken to avoid intrusion of fluid or moisture into the regulating device assembly during heating and recovery. For this the outlet nozzle, the inlet and the breather hole may be plugged.

7.9 Mechanical Strength of Connections

7.9.1 *General*

Tests for mechanical strength shall be carried out using a dynamometric device with an accuracy of ± 5 percent. For the torque test, a system which neutralizes bending moments shall be used (if a torque wrench is used, it is desirable that this is double handed). The duration of application of the moments and forces shall be 60s each.

7.9.2 *Devices Intended to be Directly Connected to a Cylinder Valve*

The point where the device is held and the test values are those shown in Table 1, 2 and 3.

7.9.3 *For the Tests Given in Table 3*

a) Devices with threaded connections, shall be mounted on its valve as indicated in the installation instructions; and
b) Devices with freely rotating quick couplings connection, the torque test of 15 N.m is not required.

In all cases the requirements of **5.14** shall be met.

7.10 Ball Drop Test

There shall be no cracking or damage to the device when a steel ball of 1 kg mass is dropped on from a height of 1 m, with the device resting on the flange or the ball falling on the flange, in special set up.

After the above test the regulating device shall be leak tight when subjected to diaphragm leak test as specified in **6.3**.

7.11 Inlet Sealing

7.11.1 Verification of satisfactory sealing by the inlet valve as per **5.5** shall be done by the procedure described in Annex L. The inlet passage of the device shall seal inflow of gas, with operating handle of device kept in OFF position and the inlet subjected to pressures of 0.5 kgf/cm^2 and maximum working pressure of the gas.

7.11.2 The test shall be carried out for a minimum period of 30 s, for each pressure.

8 SEALING

8.1 If the Device is permanently not crimped, the body and cover of each device shall be sealed to discourage interference with the internal mechanism as well as the setting.

8.1.1 The manner of sealing shall be as agreed to between the purchase and manufacturer.

9 CLASSIFICATION OF TESTS

9.1 Type Tests

The following shall constitute type test:

a) Susceptibility to season cracking (*see* **4.1.1**);
b) Rubber material test (*see* **4.3, 4.4** and **4.5**);
c) Hydrostatic test (*see* **6.2.1**);
d) Endurance test (*see* **7.6**);
e) Low and high temperature tests (*see* **7.7** and **7.8**);
f) Mechanical strength of connection (*see* **7.9**); and
g) Ball drop test (*see* **7.10**).

9.2 Routine Tests

The following shall constitute routine tests:

a) LPG compatibility (*see* **4.1**);
b) Finish (*see* **4.2.1**);
c) Dimensions (*see* **5.4);**
d) Inlet sealing (*see* **7.11**);
e) Soundness test (*see* **6**);
f) Outlet pressure (*see* **7.2**);
g) Rated capacity measurement (*see* **7.3**);
h) Chatter and performance (*see* **7.1.2** and **7.5**); and
j) Reverse flow leak test (*see* **7.4**).

10 MARKING

10.1 Each device shall be clearly and permanently marked with the following:

a) Manufacturer's name or trade mark;
b) Month and year of manufacture, for example 12-20 for December 2020;
c) Number of this standard, followed by the letter 'B' indicating butane, 'P' indicating propane or 'LPG' indicating mixtures of butane and propane;
d) Any other markings agreed to between the purchaser and manufacturer;
e) Outlet pressure/pressure range in mm WC or kgf/cm^2 or mbar or bar (as applicable);
f) Rated capacity in m^3/h or kg/h of gas; and
g) Direction for increase and decrease of the outlet pressure (where applicable) shall be clearly marked on pressure changing means.

10.2 BIS Certification Marking

10.2.1 The product(s) conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the *Bureau of Indian Standards Act*, 2016 and the Rules and Regulations framed thereunder, and the product(s) may be marked with the Standard Mark.

10.2.2 The markings may be distributed over the body as convenient and as agreed to between the purchaser and the manufacturer.

11 PACKING

The device shall be packed so as to avoid damage in transit. The openings shall be sealed off to prevent the entry of foreign matter.

ANNEX A

(*Clause* 2)

LIST OF REFERRED INDIAN STANDARDS

IS No.	*Title*
319 : 2007	Free-cutting brass rods and section — Specification (*fifth revision*)
410 : 1977	Specification for cold rolled brass sheet, strip and foil (*third revision*)
551 : 2018	Bonded abrasive products — General requirements (*fourth revision*)
617 : 1994	Cast aluminium and its alloy-ingots and castings for general engineering purposes — Specificaton (*third revision*)
713 : 1981	Specificaton for zinc base alloy ingots for die casting (*second revision*)
742 : 1981	Specification for zinc base alloy die castings (*second revision*)
2305 : 1988	Method for mercurous nitrate test for copper and copper alloys (*first revision*)
2643 : 2005	Pipe threads where pressure-tight joints are not made on the threads — Dimensions, tolerances and designation (*third revision*)
3224 : 2002	Valve fittings for compressed gas cylinders excluding liquefied petroleum gas (LPG) cylinders — Specification (*third revision*)
3400 (Part 2) : 2014	Method of test for vulcanized rubber: Part 2 Rubber, vulcanized or thermoplastic — Determination of hardness (hardness between 10 IHRD and 100 IHRD) (*fourth revision*)
3400 (Part 4) : 2012	Method of test for vulcanized rubber: Part 4 Accelerated ageing and heat resistance (*third revision*)
3400 (Part 10/Sec 1) : 2020	Methods of test for vulcanized rubbers: Part 10 Compression set, Section 1 At ambient or elevated temperatures (*second revision*)
3624 : 1987	Specification f or p ressure and vacuum gauges (*second revision*)
4218 (Part 1) : 2001	ISO general purpose metric screw threads: Part 1 Basic and design profile (*second revision*)
4218 (Part 2) : 2001	ISO general purpose metric screw threads: Part 2 General plan (*second revision*)
4218 (Part 3) : 1999	ISO general purpose metric screw threads: Part 3 Basic dimensions (*second revision*)
4218 (Part 4) : 2001	ISO general purpose metric screw threads: Part 4 Selected sizes for screws, bolts and nuts (*second revision*)
4576 : 2021	Liquefied petroleum gases — Specification (*fourth revision*)
6009 : 1970	Method for evaluation of results of accelerated corrosion test
6044 (Part 1) : 2018	Liquefied petroleum gas storage installations — Code of practice: Part 1 Residential, commercial and industrial cylinder installations (*third revision*)
6912 : 2005	Copper and copper alloy forging stock and forging — Specification (*second revision*)
8737 : 2017	Valve fittings for use with liquefied petroleum gas (LPG) cylinders of more than 5 litre water capacity — Specification (*second revision*)
9798 : 2013	Low pressure regulators for use with liquefied petroleum gas (LPG) — Specification (*second revision*)
IS/ISO 11114 (Part 1) : 2012	Transportable gas cylinders — Compatibility of cylinder and valve materials with gas contents: Part 1 Metallic materials
IS/ISO 11114 (Part 2) : 2013	Transportable gas cylinders — Compatibility of cylinder and valve materials with gas contents: Part 2 Non Metallic materials

ANNEX B

(*Clauses* 4.2.1.2 *and* 4.3.7)

METHOD OF TEST FOR ADHESION OF PAINT

B-1 A square measuring 12 to 15 mm sides shall be marked on plain surface (not having raised or sunk markings) of randomly selected specimen from the lot of painted or powder coated components. Cross lines at a distance of 1 to 1.5 mm and inched at approximately 120° angle with each other shall be described over the marked portion with a sharp pointed instrument. Cellulose tape shall be applied over this portion and left for 2 min after which is shall be jerked free from the surface under test. If a more than 3 percent of the squares are ripped from the surface under test. The specimen shall be deemed to have failed test.

ANNEX C

(*Clauses* 4.3.2, 4.3.5, 4.3.6, 4.4, 4.4 *and* E-2)

TEST GAS COMPOSITION

C-1 The test gas is nominally 50 percent propane, 50 percent propene. In practice this gas will conform to the following specification:

C-1.1 A hydrocarbon mixture consisting predominantly of C_3 hydrocarbons approximating to 50/50 propane/propene. It shall have the following composition:

a) The total content of propene shall not be less than 45 mols percent and not greater than 55 mols percent.
b) The total content of C_2 hydrocarbons shall not exceed 1 mol percent.
c) The total content of C_4 and higher, hydrocarbons shall not exceed 2 mols percent.

C-1.2 Alternatively, commercial liquefied petroleum gas (LPG) may be used as the test gas.

ANNEX D

(*Clause* 4.3.3)

BURSTING AND PULL OUT TEST OF DIAPHRAGM IN AN ASSEMBLED REGULATING DEVICE

D-1 GENERAL

D-1.1 The test is designed to give a practical result on an assembled regulating device, and is intended as a simple check method which may be applied by the regulating device manufacturer to diaphragm material which will usually have been previously tested by some other method (for example, Mullin's test) by the supplier.

D-1.2 The test takes the form of a simple application of pressure (air or nitrogen is suitable) through the outlet connection to the underside of the diaphragm mounted in a regulating device in the fully assembled condition (that is as it would be supplied by the manufacturer to a buyer).

D-2 TEST RIG

D-2.1 The outlet of the assembled regulating device is connected to a supply of air or nitrogen.

D-2.2 A gauge is incorporated in the test rig between the air or nitrogen supply and the regulating device to indicate the applied pressure.

D-3 TEST METHOD

D-3.1 The pressure is applied at approximately 1 kgf/cm^2 per second up to the level specified in **4.3.3**.

ANNEX E

(*Clauses* 4.3.5 *and* 4.4.2)

IMMERSION TEST (RESISTANCE TO HYDROCARBONS)

E-1 GENERAL

The test is designed to evaluate the rubber material *vis-à-vis* its resistance to hydrocarbons.

E-2 PROCEDURE

Weigh the sample. W_o prior to test. Immerse the same in n-pentane or test gas (as defined in Annex C) maintained at a temperature of 20 ± 5 °C for 72 h. Remove the sample and expose it to atmosphere. After 5 min, weigh the sample W_1. Next, let it stay exposed to atmosphere for 24 h and weigh W_2 and calculate the following:

a) Percentage of test gas absorbed = $(W_1 - W_2)/W_o \times 100$, and

b) Percentage of matter extracted = $(W_o - W_2)/W_o \times 100$.

E-3 The results of the above test shall be in accordance with values as given below:

Extractable Percent	+ 5 to – 12
Absorbed Percent	+ 10 to – 10

NOTE — It is permitted to wipe clean the component after removal from immersion.

ANNEX F

(*Clauses* 4.3.5 *and* 4.5.1)

METHOD OF COMPRESSION SET TEST FOR RUBBER COMPONENT MATERIAL

F-1 GENERAL

The test is designed to difference between the original thickness of the test piece and that after recovery, expressed a percentage of the initial applied compression.

F-2 APPARATUS AND TEST PIECES

The apparatus shall as per **4** of IS 3400 (Part 10/Sec 1). The pieces for test shall be as per **6** of IS 3400 (Part 10/Sec 1).

F-3 PROCEDURE

Three mono-block test piece disc of (13 +/–0.5) mm diameter and (6.3 ± 0.3) mm thickness shall be tested as per **8** of IS 3400 (Part 10/Sec 1) subjected to following conditions:

a) compression: 25 percent at (27 ± 2 °C);

b) duration of test 168 + 0/– 2 h for valve pad and seal material and 24 + 0/– 0.5 h for diaphragm; and

c) test temperature: 70 ± 1 °C

F- 4 CALCULATION

Calculate the compression set expressed as a percentage of the initial deflection from the following formula:

$$\text{Compression set, percent} = \frac{t_o - t_1}{t_o - t_8} \times 100$$

where

t_o = initial thickness, in mm of the test piece;

t_1 = thickness of the test piece, in mm after recovery; and

t_8 = height of the spacer, in mm.

the results for the three test pieces shall agree within 5 percent of the mean compression set value; if they do not, the test shall be repeated.

F-5 RESULTS

The results of the above test shall be in accordance with values as given below:

Component	Compression set, Percent
Seals and 'O' rings	40 *Max*

ANNEX G

(*Clause* 5.10)

TEST ON OUTLET PRESSURE CHANGING MEANS

G-1 DEFINITION

The pressure changing means intended for modifying the outlet pressure within the designed range of outlet pressures is externally provided on both Variable and Adjustable Regulators and is convenient to operate. The pressure in VHPR once set by user and in AHPR by technician, shall remain ‘as set’, till next change.

G-2 TEST METHOD

The inlet of the regulating device (through a regulator of suitable capacity) is connected to air supply of adequate capacity and pressure incorporating a flow meter. The outlet of the Regulator is connected to a T-connection with one end connected to a flow control valve and the other to a pressure indicating device. With inlet pressure set at 7 kg/cm^2 the outlet pressure is modified to the maximum outlet pressure and flow is measured.

ANNEX H

(*Clause* 5.12, 7.7.1 *and* 7.8.1)

TEST ON EXCESS FLOW CHECK VALVE (EFCV)

H-1 DEFINITION

The EFCV integral with the regulating device shall cause the shut off of the gas flow for values of flow rate above the rated capacity of the regulating device.

H-2 PERFORMANCE CHARACTERISTICS

The EFVC shall shutoff the gas flow in all the cases of disconnection of the flexible hose or tube fitted downstream of the regulating device. This EFCV shall operate for an increase in the rate between 120 percent and 200 percent of the rated capacity of the regulating device at an angle of ±10° relative to its axis in the fixing position(s) of the regulating device in the range and the rate obtained on hose or tube disconnections of minimum (–20 °C) and maximum temperature (+ 65 °C) conditions.

The regulating device fitted with excess flow check valve in shut off condition shall be checked for existence of any leakage. The regulating device shall be assembled as per the below scheme (*see* Fig 3.). The regulating device shall be connected to the bubble indicator through a flexible piping. The regulating device shall be subjected to lowest and highest inlet pressure and the bubble indicator shall be examined for the appearance of the bubbles. The leakage rate shall not exceed 4 Nmm^3/min.

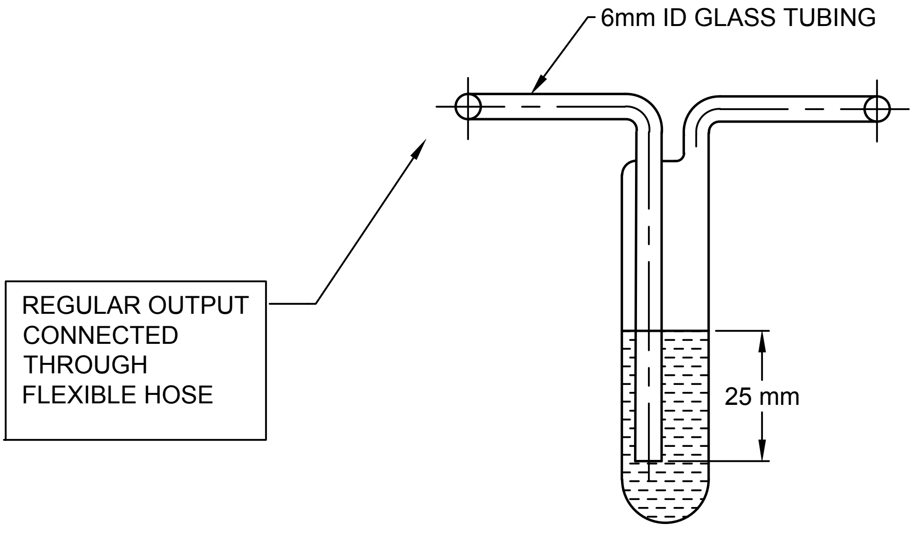


FIG. 3 EFCV TESTING SET-UP

The presence of the device shall not alter the performance of the Regulating device.

H-3 TEST METHODS

The closure caused by EFCV shall be obtained in the range defined between 120 percent and 200 percent of the rated capacity of the Regulating device.

For the endurance test the EFCV shall be subjected to a series of 100 cycles of opening/closing operations without change in operating forces, sensitivity of positioning device and without apparent traces of pitting. This test shall be carried out at ambient temperature.

H-4 INSTRUCTIONS FOR USERS

In addition to the Regulating device working instructions the manufacturer shall clearly indicate in the instructions the following information.

a) Do not move the cylinder during the use;
b) Switch off the Regulator in the event of operation of the excess flow valve;
c) Only turn on the Regulator, after having rectified the cause of the device operating; and
d) Instructions on resetting of the EFCV.

For the purpose of routine test the regulator when checked, the EFCV shall shut off the gas flow in all the cases of disconnection of the flexible hose fitted downstream of the regulator.

ANNEX J

(*Clauses* 7.6 *and* 7.8)

ENDURANCE TEST

J-1 The device is mounted on a valve or suitable inlet connection (whose outlet matches with the inlet of the device) and connected, through an air pressure regulator, to air supply and solenoid operated pneumatic valves of adequate capacity, incorporating a system which will indicate flow or lack of it (that is, a burner, flow meter or orifice in parallel with a pressure indicating device such as a manometer column). The cycles test shall be carried out for following tests:

a) For Regulating Device — Keeping the operating handle in ON position and inlet pressure at 1.5 kgf/cm^2 for butane regulators and 7 kgf/cm^2 for LPG and propane regulators and 20 percent of the maximum flow rate the solenoid valves are operated for 4 500 cycles, such that during each cycle the diaphragm relaxes completely and closes its jet for at least 1 s. The length of each complete cycle shall be at least 5 s.
b) For Regulating Device and Adaptor — Keeping all pressure and flow settings as above, the operating handle of the device shall be operated for 500 cycles.

J-2 At the end of each of the above tests, soundness as per **6.2** and **6.3** shall be ensured.

ANNEX K

(*Clause* 7.7)

LOW TEMPERATURE AND HIGH TEMPERATURE TESTS

K-1 DETERMINATION OF DIAPHRAGM FLEXIBILITY

K-1.1 Low Temperature Test

A fully assembled Device is placed in a sealed container and this container is immersed in a bath of any convenient fluid (namely, methanol or any suitable freezing mixture like salt + ice + calcium carbide) cooled to a steady temperature of –20 °C and maintained at this temperature by some reliable means (by additions of dry ice). It is kept immersed long enough for the complete assembly to attain –20 °C (10 minutes) after which it is removed and exposed to the atmosphere so that the assembly returns to ambient conditions. It is then tested in accordance with **7.5** for performance.

NOTE — Care should be taken to prevent the cooling fluid from entering the assembly or of moisture condensing inside. This may be avoided by ensuring that the sealed container is opened only after the assembly attains ambient conditions.

K-1.2 High Temperature Test

A fully assembled Device is placed in a sealed container and this container is immersed in a bath of water heated to a steady temperature of 65 °C. It is kept immersed long enough for the complete assembly to attain – 65 °C (10 min) after which it is removed and exposed to the atmosphere so that the assembly returns to ambient conditions. It is then tested in accordance with **7.5** for performance.

NOTE — Care should be taken to prevent the bath water from entering the assembly, or of moisture forming inside. This may be avoided by ensuring that the sealed container is opened only after the assembly attains ambient conditions. Also, air shall not be forced through the assembly in an attempt to accelerate cooling as this is likely to result in condensation of moisture inside the assembly.

ANNEX L

(*Clause* 7.11)

TEST FOR INLET SEALING

L-1 DEFINITION

This test ensures, that in case leakage occurs the Valve Seat due to some defect, the leaking gas is prevented from flowing into the device when the operating handle of the device is turned OFF and effectively the user has made all efforts to contain the LPG.

L-2 Test Method

A fully assembled device is mounted on a valve (whose outlet matches with the inlet of the Device). Air/gas is introduced into the device inlet at highest and lowest operating pressures and the operating handle of device is turned to ON position and occurrence of outflow confirmed. The operating handle of device is then be turned OFF. The outlet of the device is connected to a system (such as a different meter, manometer, etc) which will indicate and measure leak, if any. The rate of leakage, if any, is measured.

ANNEX M

(*Foreword*)

COMMITTEE COMPOSITION

Gas Cylinder Sectional Committee, MED 16

Organization	*Representative(s)*
Petroleum and Explosive Safety Organization, Nagpur	Shri M. K. Jhala (***Chairman***) Shri V. K. Mishra (*Alternate* I) Shri Jamunalal Rout (*Alternate* II)
All India Industrial Gases Manufacturers Association, New Delhi	Shri Saket Tiku Shri K. R. Sahasranam (*Alternate*)
Ashok Leyland Limited, Chennai	Shri Ved Prakash Gautam Shri Faustino V. (*Alternate*) Shri Suchismita Chatterjee (*Young Professional*)
Automotive Research Association of India, Pune	Dr S. S. Thipse Shri S. D. Rairikar (*Alternate*)
Bharat Petroleum Corporation Ltd, Mumbai	Shri Maneesh Patney Shri Sudipta Sarkar (*Alternate*)
Bhiwadi Cylinders Pvt Ltd, New Delhi	Shri Manvinder Singh Shri Rajneesh Chopra (*Alternate* I) Shri Sunil K. Dey (*Alternate* II)
Directorate General of Quality Assurance, Ministry of Defence, New Delhi	Col R. Dhankhar
Everest Kanto Cylinder Ltd, Mumbai	Shri Ghanshyam Goyal Sg A. G. Khamkar (*Alternate*) I) Shri A. S. V. S. Prasad (*Alternate* II)
Gujarat Gas Ltd (Formerly GSPC Gas Co Ltd), Surat	Shri Ravi Ravipalli
Hindustan Petroleum Corporation Ltd, Kolkata/Mumbai	Shri Debashish Chakraverty Shri Dilip Kumar Ray (*Alternate* I) Shri Siva Shankar (*Alternate* II) Shri Manikandan M. (*Young Professional*)
Indian Oil Corporation Ltd, Mumbai	Shri Soumitra Chakraborty Shri Sanjay Gupta (*Alternate*)
Indraprastha Gas Limited, Delhi	Shri Ujwal Bhandari Shri Sushil Kumar (*Alternate*) Shri Aviral Rajeev (*Young Professional*)
International Industrial Gases Ltd, Howrah	Shri Devendra K. Garg Shri Nikhilesh K. Garg (*Alternate*)
Inox India Limited, Vadodara	Shri Deepak V. Acharya
Kabsons Gas Equipments Ltd, Hyderabad	Shri Satish Kabra Shri S. Gopalaiah (*Alternate*)
Kosan Industries Ltd, Mumbai/Surat	Shri Girishbhai K. Desai Shri S. B. Bolmal (*Alternate*)
LPG Equipment Research Centre, Bengaluru	Shri Naresh Gera Shri Ashish Kumar Bera (*Alternate*) Shri P. R. Deodhar (*Young Professional*)

Organization	*Representative(s)*
LINDE India Ltd, Kolkata	Shri Ramana Vutukuru Shri Pardeep (*Alternate*)
Mahanagar Gas Limited, Mumbai	Shri S. Murali Shri Milind M. Ranade (*Alternate*) Shri Sachin Gumaste (*Young Professional*)
Ministry of Defence (DGQA), Pune	Jt Controller (Jag/Nfsg) Shri M. Satyanarayana Psco (*Alternate* I) Shri S. B Alhat Acqa (Ep) (*Alternate* II) Shri Shri Ram (*Alternate* III)
Research and Development Estt (Engineers), Pune	Dr Shankar Bhaumik Shri Tamhankar Ravindra (*Alternate*)
Saka Engineers Private Limited, New Delhi	Shri Amarjit S. Kohli
Society of Indian Automobile Manufacturers, New Delhi	Shri K. K. Gandhi Shri Amit Kumar (*Alternate*)
Steel Authority of India Ltd, (SAIL), RDCIS, Ranchi	Shri S. K. Mohapatra Shri Santosh Kumar (*Alternate*)
Tata Motors Ltd, Pune	Shri Pallipalayam Gowrishankar Shri Shailendra Dewangan (*Alternate*)
Tekno Valves, Kolkata	Shri Y. K. Behani Shri Rohit Behani (*Alternate*)
The Automotive Research Association of India, Pune	Dr S. S. Thipse Shri S. D. Rairikar (*Alternate*)
Trans Valves (India) Pvt Ltd, Hyderabad	Shri Anand Kumar Jain Shri Pradeep Kumar Mathur (*Alternate*)
Vanaz Engineers Pvt Ltd, Pune	Shri S. J. Vispute
BIS Directorate General	Shri Rajneesh Khosla, Scientist 'E' and Head (MED) [Representing Director General (*Ex-officio*)]

Member Secretary
Shri Chandan Gupta
Scientist 'D' (MED), BIS

Gas Cylinder Valves and Fittings Subcommittee, MED 16 : 1

Organization	*Representative(s)*
Tekno Valves, Kolkata	Shri Y. K. Behani (***Convener***) Shri R. Behani (*Alternate*)
All India Industrial Gases Manufacturers Association, New Delhi	Shri Saket Tiku
Batra Associates Limited, Faridabad	Shri N. K. Sawhney
Bharat Petroleum Corporation Ltd, Mumbai	Shri Maneesh Patney Shri Sudipta Sarkar (*Alternate*)
Everest Kanto Cylinder Ltd, Mumbai	Shri Ghanshyam Goyal
	Sg A. G. Khamkar (*Alternate* I) Shri A. S. V. S. Prasad (*Alternate* II)

Organization	*Representative(s)*
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Indian Oil Corporation Ltd, Mumbai	Shri Soumitra Chakraborty Shri Sanjay Gupta (*Alternate*)
Jai Gopal Engg Works Pvt Ltd, Delhi	Shri Jai Gopal Mehta Shri A. K. Gupta (*Alternate*)
Kabsons Gas Equipments Ltd, Hyderabad	Shri Satish Kabra
Kosan Industries Ltd, Mumbai/Surat	Shri Girishbhai K. Desai Shri S. B. Bolmal (*Alternate*)
L P G Equipment Research Centre, Bangaluru	Shri Naresh Gera Shri Ashish Bera (*Alternate*)
Petroleum and Explosives Safety Organisaton, Nagpur	Shri M. K. Jhala Shri V. K. Mishra (*Alternate* I) Shri Jamunalal Rout (*Alternate* II)
Southern Metals and Alloys Pvt Ltd, Mumbai	Shri Vivek Noronha
Tomasetto Achille India Pvt Ltd, Thane	Shri Amit Kumar Shah Shri Rakesh Gurunath Patil (*Alternate*)
Trans Valves (India) Pvt Ltd, Hyderabad	Shri Anand Kumar Jain Shri Pradeep Kumar Mathur (*Alternate*)
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